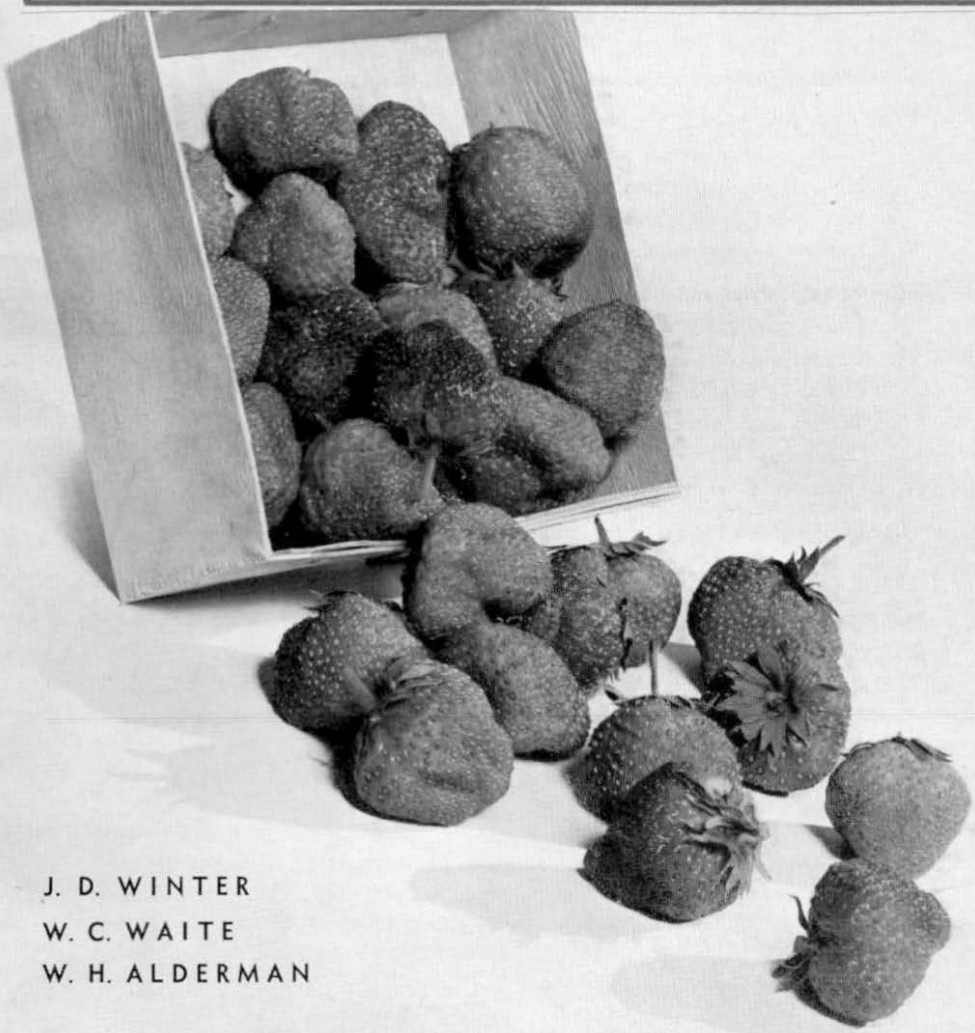
BULLETIN 332 // JANUARY 1937

MARKET OUTLETS FOR MINNESOTA FRUITS



J. D. WINTER
W. C. WAITE
W. H. ALDERMAN

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

CONTENTS

MARKET OUTLETS FOR MINNESOTA FRUITS

J. D. WINTER, W. C. WAITE, W. H. ALDERMAN

INTRODUCTION

This publication presents a preliminary study of the marketing problems of Minnesota-grown fruits with special reference to the possible utilization of these fruits in commercial manufacture. During the last decade improved methods of packing and shipping perishable fruits from other regions have placed competing fruits on the local markets far in advance of the local crop season. Early pickings of local berries, for example, no longer bring the high prices that were received formerly for the early local crop. Moreover, there is some tendency toward increased local production. For these reasons it is increasingly important for local growers to endeavor to secure an adequate distribution for their crop, especially during the peak of production, if they are to receive a fair average price for the season.

If growers endeavor to extend their markets by the shipment of berries, attention must be given to the legal requirements for shipment and transportation rates. The federal requirements governing shipments outside the state and the state regulations governing shipments within the state, in consequence, have been discussed. There is also a study of the transportation rates on fresh strawberries and raspberries between 20 Minnesota and Wisconsin shipping points and 30 consuming markets.

The possibilities of a greater utilization of Minnesota-grown fruits for commercial manufacture, particularly during the peak of production, are of considerable importance.

THE FRESH FRUIT MARKET FOR RASPBERRIES AND STRAWBERRIES

Estimated Commercial Production in 1935 and 1936

No statistics have been available showing the total volume of raspberries and strawberries produced commercially in Minnesota. Records of the sales of berry boxes to Minnesota growers by eight factories in Minnesota, Wisconsin, and Iowa were secured. The eight factories that co-operated are believed to supply almost all the berry containers used by commercial growers in Minnesota. These factories made available their records of shipments and sales for 1935 and in some instances also similar records for previous years. Some additional data were secured from other sources where factory records were incomplete.

Tho a survey of production made on this basis can not be wholly accurate, it probably affords a more reliable index of commercial production than can be secured in any way other than a farm-to-farm census.

Sales of berry boxes during 1935 in Minnesota, according to these records, totaled 1,816,146 pints and 2,312,139 quarts. These records do not include any corrections for berry boxes held over by growers from the previous year, or for boxes purchased in 1935 but not used. It is probable that relatively few crates were carried over from 1935 to 1936, and in 1935 growers did not have many strawberry crates held over from the previous year. However, there was a considerable carry-over of raspberry crates in 1935 from the previous year, so that with proper allowance made for this factor the total for raspberries in 1935 would be approximately 2,000,000 pints.

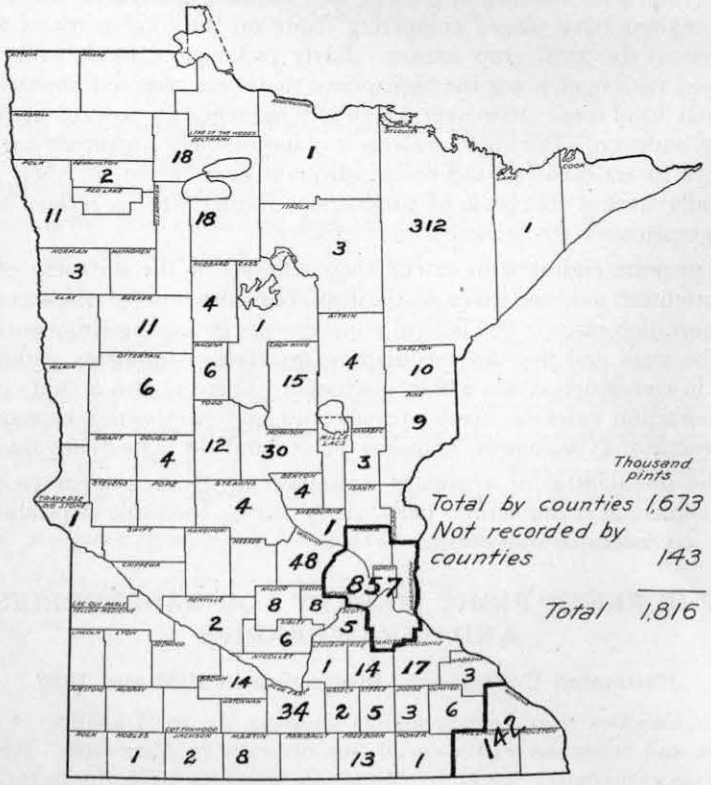


FIG. 1. SALE AND DISTRIBUTION, BY COUNTIES, OF PINT BERRY BOXES FROM BOX FACTORIES IN 1935
(Numbers indicate thousands of boxes sold)

The number of pint and quart berry boxes (in thousands) shipped into each county during 1935 is shown in Figures 1 and 2, except for counties where less than 1,000 pints or quarts were recorded. For the purpose of this survey, it is assumed that all pint boxes were used for

raspberries and all quart boxes for strawberries, altho some ever-bearing strawberries are marketed in pint boxes and some use is made of quart boxes for other fruits. Most of the factory records made it possible to separate boxes sold for blueberries, but this could not be done in all instances. The quart boxes shown for Cook County undoubtedly represent mostly blueberries. Obviously, these records fail to include any production sold direct to consumers who pick the berries into containers other than regular berry boxes. The record by counties does not include 128,345 pint and 272,726 quart berry boxes for which shipping or delivery records were not available.

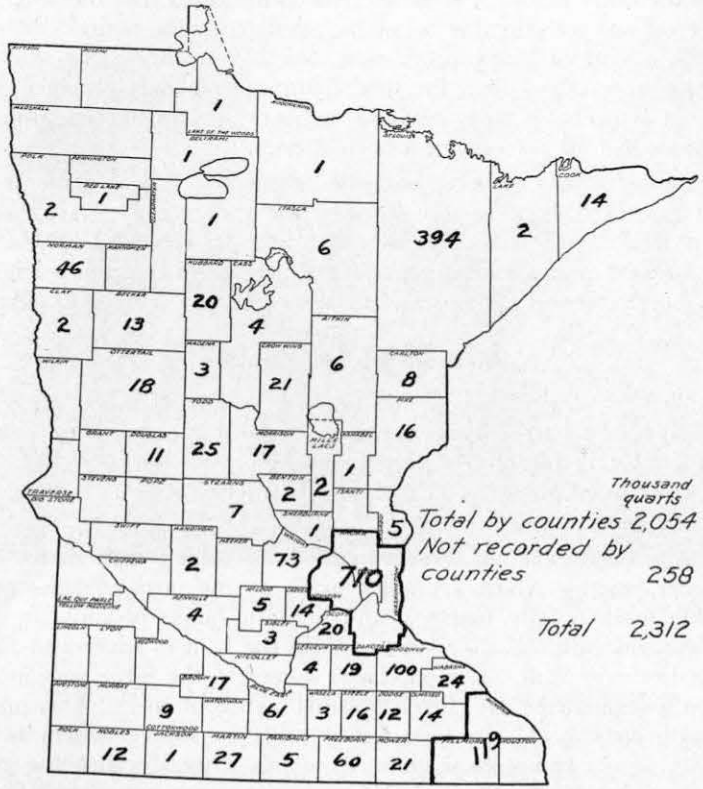


FIG. 2. SALE AND DISTRIBUTION, BY COUNTIES, OF QUART BERRY BOXES FROM BOX FACTORIES IN 1935
(Numbers indicate thousands of boxes sold)

Records for the Twin City area (including five counties) were grouped because distribution records made it impossible to determine the approximate quantity of berry boxes used in each of these counties. The same is true of three counties in southeastern Minnesota. It is in-

teresting to note that the Twin City area apparently produced about 51 per cent of the total volume of raspberries and about 34 per cent of the strawberries grown in the state in 1935.

An examination of the shipping records of berry marketing associations and of box manufacturers indicated that the 1935 strawberry production in Minnesota represented an average production for the period 1929-1935, excluding the severely reduced crop of 1934. The production per acre in 1935 was unusually heavy, but reduced acreage due to drouth conditions in 1933 and 1934 held the total volume to approximately that of an average crop for the state.

On the other hand, these same records indicated that the 1935 raspberry crop was considerably below the average for the period 1929-1935. In 1929, a year of heavy production, one box factory alone sold more pint raspberry boxes than the total quantity sold by eight factories in 1935. It is probable that the 1935 raspberry production in Minnesota did not exceed 50 per cent of a normal crop.

A similar survey of berry-box sales in Minnesota was made in 1936, except that records were not obtained for each county. According to records secured in this survey, sales in Minnesota totaled 2,200,000 pints and 2,700,000 quarts, indicating a slight increase in the commercial crop of raspberries over 1935 and an increase of 15 per cent in strawberries.

Methods of Distribution

Almost the entire crop of Minnesota-grown raspberries and strawberries is sold as fresh fruit for table use or for home preserving and canning. Marketing is conducted through three different channels: (1) Direct to consumer, (2) to retail distributor, and (3) through co-operative marketing associations.

The grower employs several methods in selling fruit direct to the consumer, among which are sales made at the farm, owner-operated roadside markets, city markets, and house-to-house peddling by truck. A recent innovation is the plan by which the fruit is advertised for sale on the bush or plant. The purchaser comes to the farm and picks the fruit at a stipulated price, furnishing his own containers. This plan has met with considerable success, but it must be supplemented by other methods of marketing to dispose of surplus fruit, because the grower must try to maintain a reserve supply of fruit to accommodate a fluctuating demand. In recent years growers have received from 9 to 12 cents a pound for raspberries and 6 to 8 cents a pound for strawberries, without any expense for picking or for containers.

Retail distributors handle a large volume of the crop. These consist of retail merchants, operators of roadside markets, and truck peddlers.

There are six active co-operative berry marketing associations in Minnesota. These are the Afton Fruit Growers Association at Afton, the Cuyuna Range Fruit Growers Association (organized in 1936),

the Excelsior Fruit Growers Association at Excelsior, the Head-of-the-Lakes Fruit Growers Association at Duluth, the Howard Lake Fruit Growers Association at Howard Lake, and the Minnetonka Fruit Growers Association at Long Lake. The total quantity of raspberries handled by the five associations in 1935 was 21,489 24-pint crates. The total quantity of strawberries handled by the same associations in 1935 was 758 16-quart crates and 19,823 24-quart crates. It should be taken into consideration that production of raspberries was decidedly below normal in 1935. These associations handle only a part of the total commercial crop in Minnesota.

FIG. 3. WEIGHING BERRIES THAT ARE SOLD BY THE POUND TO CUSTOMERS WHO PICK THEIR OWN FRUIT

Established Grades and Legal Measures for Berries

The proper grading of fruit is so closely identified with marketing problems that it is important for the grower to have a clear understanding of grade requirements. The grade refers to the character or the quality of the fruit. The legal measures refer to the size of containers for the fruit or the weights of the fruit contained therein. Grading is permissive; that is, the grower may grade his fruit if he desires, but the use of the legal measures is mandatory. Each grower, in consequence, should be familiar with the state and federal legal measures for the fruit that he places on the market. He should also consider the advantages that might be secured in grading his own fruit and be well informed regarding the customary grading of fruit that comes into direct competition with his own.

There are no Minnesota state grades for berries, but there are standards recommended by the United States Department of Agriculture for both raspberries and strawberries. If berries are graded according to these standards, the federal grade designations may be used. These standards are given below.

U. S. Standards for Raspberries

The United States Department of Agriculture recommends the following standards for use in grading raspberries:

U. S. No. 1 shall consist of raspberries of one variety which are well colored, well developed and not soft, overripe or broken; which are free from cores, sunscald, mold and decay, and from damage caused by dirt or other foreign matter, shriveling, moisture, disease, insects, mechanical or other means.

In order to allow for variations incident to proper grading and handling, not more than 10 per cent, by volume, of the raspberries in any container[1] may be below the requirements of this grade, but not to exceed one-half of this tolerance, or 5 per cent, shall be allowed for defects causing serious damage, and not more than one-fifth of this amount, or 1 per cent, may be affected by mold or decay.

U. S. No. 2 shall consist of raspberries of one variety which are not graded in conformity with the foregoing grade and which do not contain more than 10 per cent, by volume, of raspberries that have been seriously damaged from any cause, but not more than one-fifth of this amount, or 2 per cent, may be affected by mold or decay.

Unclassified shall consist of raspberries which are not graded in conformity with either of the foregoing grades.

The terms used in these grades are defined as follows: "Well colored" means that the whole surface of the berry shows a color characteristic of a mature berry. "Well developed" means that the berries shall not be misshapen owing to anthracnose injury, frost injury, lack of pollination, insect injury, or other causes. "Overripe" means dead ripe or soft, necessitating immediate consumption. "Damage" means any injury or defect that materially affects the appearance, or edible or shipping quality. "Serious damage" means berries that are badly deformed, crushed, leaky, moldy, decayed, or otherwise seriously injured. Berries that have poor color characteristic of immature berries or berries from which the core has not been removed shall be considered as seriously damaged.

[1] The tolerances specified for the various grades are placed on a container basis. However, any lot of raspberries shall be considered as meeting the requirements of a specified grade, if upon inspection no sample from the containers in any lot is found to exceed the tolerances specified by more than one-half the amount allowed, provided that the entire lot shall average within the tolerances specified.

U. S. Standards for Strawberries

The following standards are recommended by the United States Department of Agriculture for use in grading strawberries:

U. S. No. 1 shall consist of strawberries of one variety, with the cap (calyx) attached, which are firm, not overripe, underripe, or undeveloped, and which are free from mold or decay and from damage caused by dirt, moisture, foreign matter, disease, insects, or mechanical or other means. *Unless otherwise specified,* the minimum size shall be not less than three-quarters of an inch in diameter.

To allow for variations other than size incident to proper grading and handling, not more than 10 per cent, by volume, of the strawberries in any lot may be below the requirements of this grade, but not to exceed one-half of this tolerance, or 5 per cent, shall be allowed for defects causing serious damage, and not more than one-fifth of this amount, or 1 per cent, shall be allowed for decay.

In addition, not more than 5 per cent, by volume, of the strawberries in any lot may be below the specified minimum size.

U. S. No. 2 shall consist of strawberries which are free from decay and from serious damage caused by disease, insects, mechanical, or other means. *Unless otherwise specified,* the minimum size shall be not less than five-eighths of an inch in diameter.

To allow for variations other than size incident to proper grading and handling, not more than a total of 10 per cent, by volume, of the strawberries in any lot shall be allowed for defects causing serious damage, but not to exceed three-tenths of this amount, or 3 per cent, shall be allowed for strawberries affected by decay.

In addition, not more than 5 per cent, by volume, of the strawberries in any lot may be below the specified minimum size.

Unclassified shall consist of strawberries which are not graded in conformity with either of the foregoing grades.

The terms used in these grades are defined as follows: "Overripe" means dead ripe, becoming soft, a condition unfit for shipment and necessitating immediate consumption. "Underripe" means so immature that less than two-thirds of the surface of the berry is of a pink or red color. "Undeveloped" means not having attained a normal shape and development owing to frost injury, lack of pollination, insect injury, or other causes. "Button" berries are the most common type of this condition. "Damage" means any injury from the causes mentioned which materially affects the appearance or edible or shipping quality. "Serious damage" means that the strawberries are soft, badly deformed, badly bruised, leaky, or otherwise seriously injured. Strawberries which are caked with dirt or which show no pink or red color shall be considered seriously damaged. "Diameter" means the greatest dimension at right angles to a straight line running from the stem to the apex.

Grades Used by Co-operative Associations

In 1934 a survey was conducted among the principal berry shipping associations in the United States to determine what grades were being used. Data were secured from 30 of these associations, and a tabulation is shown in Table 1 which indicates that more than half of the associations are using the U. S. grades or their equivalent.

Table 1. Grades Used by 30 Co-operative Shipping Associations for Raspberries and Strawberries, 1934

Associations using the U. S. grades	16
Associations using two grades (approximately same as U. S. Grades)	3
Associations using two grades (different from U. S. Grades)	4
Associations using one grade only (different from U. S. Grades)	7
Total	30

The co-operative shipping associations in Minnesota commonly use two grades which are designated as (1) fancy and (2) commercial. These two grades correspond in general with U. S. No. 1 and U. S. No. 2. In 1935 one of these associations reported an average price for the fancy grade of raspberries which was 23 per cent above the average price for the commercial grade. The fancy grade of strawberries brought 24 per cent above the average price for the commercial grade, thus demonstrating the importance of producing fruit of the best market grade.

State and Federal Legal Measures

Regulations of the Minnesota State Department of Agriculture provide that all strawberries and raspberries offered for sale in Minnesota must bear on all crates the date of packing and the name of the grower or the name of the shipping association and grower's number. The repacking of the original pack for the purpose of increasing the number of cups or crates is prohibited. Investigations by the Minnesota State Department of Agriculture have shown that the net weight of raspberries offered for sale in pint boxes by retail merchants may vary from 6½ to 11 ounces, with many averaging between 8 and 9 ounces net weight of fruit. It is evident that in many instances either the berries have been "repacked" or the boxes were not properly filled by the grower even when an allowance is made for normal shrinkage.

The weight of a full pint of raspberries will vary as much as two ounces depending on the variety, size, and moisture content of the berries. Similarly, the weight of a full quart of strawberries will vary as much as three ounces.

Much depends on the way the berries are packed. Figure 4 on the right shows a 24-pint crate of raspberries containing 16½ pounds net weight of fruit. On the left in the same figure are shown the same

berries "repacked" to fill one crate and 5 pints. The average person would see no appreciable difference in the quantity of berries per box because in both lots the boxes appeared to be well filled. However, the crate on the right contains 16½ pounds of berries and the crate on the left contains about 13½ pounds of berries, or approximately 9 ounces per pint box.

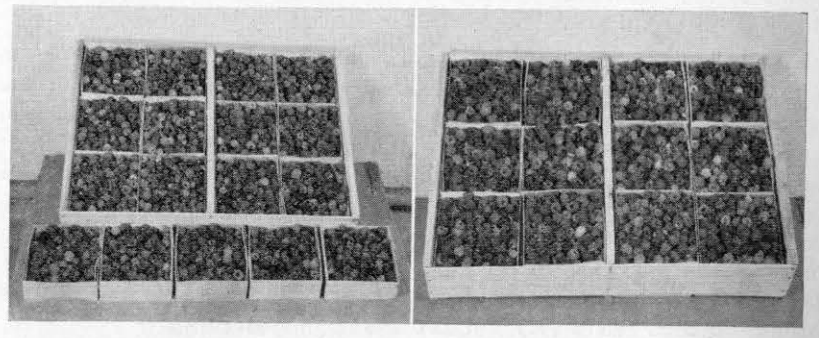


FIG. 4. RIGHT: CRATE OF RASPBERRIES CONTAINING 16½ POUNDS OF BERRIES (FORMER LEGAL WEIGHT IN MINNESOTA); LEFT: THE SAME BERRIES "REPACKED" TO FILL THE SAME CRATE AND FIVE ADDITIONAL PINT BOXES

The United States Standard Container Act requires that berry boxes and other containers for small fruits shall be of the following capacities: dry ½ pint, dry 1 pint, dry 1 quart, or multiples of the dry 1 quart. It further provides that the standard dry pint shall contain 33.6 cubic inches and that the standard dry quart shall contain 67.2 cubic inches.

Until recently, legal regulations in Minnesota provided that a pint of raspberries shall weigh 11 ounces and that a quart of strawberries shall weigh 20 ounces, not including the container. These regulations have been superseded by the requirement that the container shall be full when offered for sale. Only new containers may legally be used, and these must conform to the provisions of the United States Standard Container Act.

Shipping Weights

When shipping crates of berries in large quantities it has been customary to bill the crates at a uniform weight rather than attempt to weigh the crates individually or collectively. A 24-pint crate of raspberries usually is billed at 20 pounds, a 16-quart crate of strawberries at 25 pounds, and a 24-quart crate of strawberries at 35 pounds. A 24-pint crate contains about 17 pounds net weight of raspberries when delivered by the grower if the boxes are full, and a 24-quart crate contains about 30 pounds net weight of strawberries.

Express Transportation

Berries that are shipped considerable distances generally move by express. The grower ordinarily will receive approximately the wholesale price in the consuming center for his type and quality of berry less the cost of transportation to that center and possibly a margin which is deducted for handling. The express rates from the various shipping points to the consuming markets are, in consequence, of importance in the price to producers.

Rates have been secured for L.C.L. shipments between 20 Minnesota and Wisconsin shipping points and 30 consuming markets to which these berries are shipped.[2] In a few cases the express company allows special rates on lots of 300 pounds or more. In the following computations these rates were used in the place of the L.C.L. rates between the markets where offered. Carlot rates were in effect only between Bayfield, Wisconsin, Excelsior, the Twin Cities, and Sparta, Wisconsin, and one or more of the following cities: Aberdeen, Chicago, Devils Lake, Fargo, Duluth, Grand Forks, Huron, Kansas City, Milwaukee, the Twin Cities, Minot, Omaha, Sioux City, Sioux Falls, and Watertown.

The rates given are those prevailing in the summer and fall of 1935. Any considerable movement of berries between specified points might lead the Interstate Commerce Commission to specify special rates upon request of the interested parties. In consequence, the rate structure for berries can not be looked upon as a permanent arrangement but is subject to modification upon an increase in the demand for services. Growers should be on the alert to seek these changes as occasion arises. Analysis, however, is possible only on the basis of the existing rate structure.

Table 2 gives the express rate on L.C.L. shipments of berries on the basis of 35-pound crates from each of the 20 shipping points. An average rate for the 30 markets and for markets located in five areas—the Dakotas, the Twin Cities, Southern markets, Milwaukee and Chicago, and Duluth—has been computed. The Dakota markets include Sioux Falls, Watertown, Aberdeen, Huron, Rapid City, Fargo, Grand Forks, Devils Lake, Minot, and Mandan. The southern group of markets includes Omaha, Kansas City, Sioux City, Des Moines, Davenport, Mason City, Fort Dodge, and La Crosse. Where more than one market is included in the receiving area, the express rates have been weighted by the populations of the included markets, on the assumption that the rates to the larger markets were more important than those to the smaller markets. The lowest rate to any market from the designated point or

[2] The shipping points were: Aitkin, Albert Lea, Bayfield, Wis., Bemidji, Brainerd, Duluth, Excelsior, Faribault, Grand Rapids, Howard Lake, Long Lake, La Crescent, La Crosse, Wis., Mankato, Twin Cities, Rochester, Sparta, Wis., Virginia, Warrens, Wis., and Winona. The consuming markets were Aberdeen, S. D., Alexandria, Bemidji, Chicago, Ill., Crookston, Davenport, Iowa, Des Moines, Iowa, Devils Lake, N. D., Duluth, Fargo, N. D., Fergus Falls, Fort Dodge, Iowa, Grand Forks, N. D., Huron, S. D., Kansas City, Mo., La Crosse, Wis., Mandan, N. D., Mankato, Marshall, Milwaukee, Wis., Minneapolis, St. Paul, Minot, N. D., Omaha, Neb., Pipestone, Rapid City, S. D., St. Cloud, Sioux City, Iowa, Sioux Falls, S. D., and Watertown, S. D.

area is given at the bottom of the table, and the excess rates to the other markets above this minimum are in the rows following the designated market. Thus, La Crosse with a rate of 41½ cents per crate has the lowest average weighted rate to all the 30 markets. La Crescent has a rate 10 cents above this, or 51½ cents per crate. The rate from any shipping point to the designated market may thus be obtained by adding the excess of rate of that market above the lowest to the lowest rate. For all the 30 markets, La Crosse, Sparta, and Warrens have an advantage largely because of the importance of Chicago in determining the rate. For the Dakotas, Brainerd, Howard Lake, and Albert Lea have the lowest rates. For the Southern markets, Albert Lea, La Crosse, La Crescent, and Sparta have advantages. For Milwaukee and Chicago, Sparta, La Crosse, and Warrens have the lowest rates. For the Twin Cities and Duluth, the local growers have distinct advantages, with a considerable number of shipping points at somewhat similar, higher rates.

Table 2. Excess of L.C.L. Express Rates on Berries Over Express Rate from Market of Lowest Cost on Crates of 35 Pounds

Shipping point	Thirty markets	Dakotas markets	Twin Cities and Minnesota	Southern markets	Milwaukee and Chicago	Duluth
Aitkin	36½	7	33	27	53	22
Albert Lea	18½	3	22	0	34	37
Bayfield	17½	24	55	36	16	41
Bemidji	47½	6	37	39	66	33
Brainerd	37½	0	27	26	56	27
Duluth	31½	11	27	27	47	0
Excelsior	25	6	17	13	42	27
Faribault	25	6	18	13	42	27
Grand Rapids	42	13	37	37	58	22
Howard Lake	31½	0	19	16	51	33
Long Lake	25	6	17	13	42	27
La Crescent	10	24	33	6	17	41
La Crosse	0	24	23	5	0	62
Mankato	25	6	18	13	42	27
Minneapolis	23	6	0	12	42	27
Rochester	18½	11	18	10	33	33
Sparta	2½	26	55	7	0	65
Virginia	39	16	37	36	54	19
Warrens	5½	24	49	18	3	55
Winona	16½	20	23	12	26	37
Lowest rate	41½	61	0	59	34	0

The lowest rate plus the excess gives the rate to each market from the specified destinations.

Except where special tariffs are in effect, express rates are constructed upon a system of blocks and sub-blocks. Each block includes a territory roughly 45 to 50 miles from east to west in Minnesota and 69 miles north and south. Each block is composed of 16 sub-blocks. Within the block and to neighboring blocks rates are constructed by sub-blocks, but for greater distances the rate is uniform for an entire block. Thus, the express rate from any point in the block containing Minneapolis to any point in the block containing Grand Forks, N. D., will be

the same as the express rate between Minneapolis and Grand Forks. Minnesota lies in about 36 blocks as shown in Figure 5.

Typical rates for shipments within the territory are given in Table 3. Examination of this table will show that beginning with a basic rate of 64 cents per hundred pounds for nearby shipments, the rate increases by approximately 20 cents per hundred pounds for each 50-mile increase in distance. For shipments within the state of Minnesota, a lower scale applies which lowers the second-class rate as usually calculated for certain commodities at 75 per cent of first class to 50 per cent of first class for intrastate movements. This gives a decided advantage to Minnesota growers in shipping to points within the state itself. There are no similar advantages to shipments outside the state. For example, second-class rates on shipments from Bemidji to Duluth are 93 cents per hundred pounds and $1.16 per hundred pounds from Bayfield, Wisconsin, which

FIG. 5. PRINCIPAL SHIPPING AND RECEIVING POINTS FOR MINNESOTA BERRIES AND EXPRESS RATE BLOCKS FOR THE TERRITORY

The receiving centers are designated by the solid dots. The shipping points are designated by number as follows: 1, Aitkin; 2, Albert Lea; 3, Bemidji; 4, Brainerd; 5, Excelsior; 6, Faribault; 7, Grand Rapids; 8, Howard Lake; 9, La Crescent; 10, Long Lake; 11, Mankato; 12, Minneapolis-St. Paul; 13, Rochester; 14, Virginia; 15, Winona; 16, Bayfield; 17, La Crosse; 18, Sparta; 19, Warrens.

appears even closer on the map. Comparing La Crosse, Wisconsin, and La Crescent, Minnesota, which are on opposite sides of the Mississippi River, we find La Crescent enjoying an advantage of 58 cents per hundred pounds on second-class rates to Duluth, a 65-cent advantage to Marshall, and a 73-cent advantage to Fergus Falls. La Crescent also has an advantage of 46 cents per hundred pounds on the second-class rate to the Twin Cities. La Crosse, however, has a special rate of 65 cents per hundred pounds on berries shipped in lots of 300 pounds or more, which gives it an advantage of 28 cents per hundred pounds over La Crescent when shipments are of that size.

Table 3. Typical Express Rates per 100 Pounds for Berries Shipped Various Distances in the Western Territory and in Minnesota

Shipments traveling a distance of—	Usual rate established by Interstate Commerce Commission for this territory	Rate established for shipments within Minnesota
miles	cents	cents
0 - 12½	64	43
12½ - 25	67	45
25 - 37½	71	48
37½ - 50	75	50
50 - 75	82	55
75 -100	94	63
100 -150	116	78
150 -200	139	93
200 -250	157	105
250 -300	176	118

The Twin Cities are the largest single market in the state for berries. Therefore, the relative advantage in express rates of shipping to Minneapolis–St. Paul rather than to other consuming centers is important. This comparison has been made in Table 4 for the 20 shipping points. The compared destinations are the same as those used previously for the average weighted rates, namely, Milwaukee and Chicago, Omaha and the South, the Dakotas, and Duluth. The table is constructed from the difference in the express rate between the shipping point and the Twin Cities and the rate from the shipping point to the designated alternative market. For example, the weighted express rate from La Crescent to Chicago-Milwaukee is 18 cents more per crate than the express rate from La Crescent to the Twin Cities. In consequence, when the price in the Twin City market is less than the Milwaukee-Chicago price by 20 cents, shipments from La Crescent may be made to Milwaukee-Chicago with an advantage of 2 cents in net return over shipments made to the Twin Cities. Or when the price in the Southern markets is above the Twin City price by 40 cents, shipments may be made to those markets from Albert Lea with a 3-cent advantage in return over shipments made to the Twin Cities. A market is entered in the table only at the point where diversions from the Twin City market

first become advantageous. Greater differences in price between the Twin Cities and the alternative market, of course, widen this advantage correspondingly. Shipping points which lie far down in the table are those most restricted to the Twin Cities as an outlet for their berries, while those toward the top have other outlets becoming advantageous as Twin City prices drop relative to alternative markets.

It is evident that if prices in the Dakotas exceeded Twin City prices by 40 to 50 cents, a large number of Minnesota markets would find more advantageous outlets at Dakota points. Prices in the southern markets

Table 4. Differences in Market Prices at Which Shipments to Various Alternative Markets Will Bring Larger Returns Than Shipments to the Twin Cities

When the Price in the Twin City Market Is Less Than the Price at the Alternative Market of:

	Milwaukee-Chicago	Southern Markets	Dakotas	Duluth
By 10 cents Shipments may be made from:				Excelsior 0¢ Faribault 1¢ Long Lake 0¢ La Crescent 3¢ Mankato 1¢ Sparta 0¢
By 20 cents Shipments may be made from:	La Crescent 2¢	La Crosse 5¢[a] Sparta 9¢[a]		Albert Lea 5¢ Howard Lake 6¢ La Crosse 7¢[a] Rochester 5¢ Winona 6¢
By 30 cents Shipments may be made from:		Warrens 2¢[a]	Bayfield 0¢[a] Bemidji 0¢[b]	Twin Cities 3¢
By 40 cents Shipments may be made from:	Winona 0¢	Albert Lea 3¢ La Crescent 8¢[a]	Aitkin 5¢[b] Brainerd 6¢[b] Grand Rapids 3¢[b] La Crosse 5¢[a] Sparta 8¢[a] Virginia 0¢[b] Warrens 5¢[a]	
By 50 cents Shipments may be made from:	Albert Lea 4¢ Rochester 1¢	Bayfield 10¢[a] Winona 2¢	Albert Lea 8¢ Duluth 3¢ Excelsior 0¢ Faribault 1¢ Howard Lake 8¢ Long Lake 0¢	
By 60 cents Shipments may be made from:	Aitkin 7¢[b] Duluth 6¢[b] Excelsior 1¢ Faribault 2¢ Grand Rapids 5¢[b] Long Lake 1¢ Mankato 2¢ Virginia 9¢[b]	Aitkin 7¢[b] Duluth 1¢[b] Brainerd 2¢[b] Excelsior 5¢ Faribault 6¢ Grand Rapids 1¢[b] Howard Lake 4¢ Long Lake 5¢ Mankato 6¢ Rochester 9¢ Virginia 2¢[b]	Mankato 1¢ Rochester 6¢ La Crescent 8¢ Winona 2¢	
By 70 cents Shipments may be made from:	Bemidji 7¢[b] Brainerd 7¢[b] Howard Lake 4¢	Bemidji 9¢[b]	Twin Cities 2¢	
By 80 cents Shipments may be made from:	Twin Cities 4¢	Twin Cities 9¢		

The small figures show the gains in net returns, other things being equal.

[a] Greater net returns will still result from shipping to markets of Milwaukee-Chicago.

[b] Greater net returns will still result from shipping to Duluth.

would need to be 50 to 60 cents higher before a large number of markets would find it advantageous to divert their shipments from the Twin Cities. A similar situation holds true with respect to Chicago.

The shipping point with the lowest express rate to each of 20 receiving markets is given in Table 5 together with the shipping points with express rates within 10 cents per 35-pound crate of the market with the lowest rate. For example, Howard Lake with a rate of 55 cents per crate has the lowest rate to Aberdeen, S. D., but Excelsior, Faribault, Brainerd, Long Lake, Mankato, and the Twin Cities all have a 62-cent rate to Aberdeen. Thus, while Howard Lake has an advantage of rate to the Aberdeen market, six other shipping points have nearly as good opportunities of reaching that market. On the other hand, none of the Minnesota shipping points have rates within 10 cents of the Sparta and Warrens rates to Milwaukee or the La Crosse and Sparta rates to Chicago. It is naturally advantageous to a shipping point to be in the comparatively low-rate group for a number of markets, and to be favorably situated to a market or markets where comparatively few other shipping points have similar advantages.

Table 5. Express Rates To Given Receiving Markets from Various Shipping Points for 35-pound Crates

Receiving market	Shipping points with lowest rate to the receiving market	Shipping points with express rates per crate within 10 cents of point with lowest rate
Aberdeen, S. D.	Howard Lake—55¢	Excelsior, Faribault, Brainerd, Long Lake, Mankato, Twin Cities—62¢
Chicago, Ill.	La Crosse, Sparta—35¢	Warrens—39¢
Crookston, Minn.	Bemidji—28¢	Grand Rapids—33¢; Aitkin, Howard Lake, Virginia—37¢
Davenport, Ia.	La Crescent, La Crosse—44¢	Sparta—49¢; Winona—51¢
Des Moines, Ia.	Albert Lea, Sparta—49¢	La Crosse, La Crescent—55¢
Devils Lake, N. D.	Bemidji, Brainerd—62¢	Aitkin, Grand Rapids, Howard Lake—69¢
Fargo, N. D.	Brainerd—41¢	Aitkin, Bemidji, Howard Lake—49¢
Grand Forks, N. D.	Bemidji, Brainerd—49¢	Aitkin, Grand Rapids, Howard Lake—55¢
Huron, S. D.	Excelsior, Faribault, Howard Lake, Long Lake, Mankato, Twin Cities—62¢	Albert Lea, Brainerd, Rochester—69¢
Kansas City, Mo.	Albert Lea, La Crosse, La Crescent, Sparta—75¢	Rochester, Winona—82¢
Mandan, N. D.	Brainerd, Howard Lake—69¢	Aitkin, Bemidji—75¢
Mason City, Ia.	Faribault, Mankato—22¢	Albert Lea—27¢; Excelsior, Long Lake—28¢
Milwaukee, Wis.	Sparta, Warrens—29¢	La Crosse—33¢
Minneapolis	Excelsior, Long Lake—17¢	Faribault, Mankato, Rochester—18¢; Howard Lake—19¢; Albert Lea—22¢; La Crosse, Winona—23¢; Brainerd, Duluth—27¢
Minot, N. D.	Albert Lea	
Omaha, Neb.	Albert Lea—55¢	
Rapid City, S. D.	Howard Lake—92¢	Albert Lea, Bemidji—97¢
Sioux City, Ia.	Albert Lea—37¢	
Sioux Falls, S. D.	Albert Lea—49¢	Excelsior, Faribault, Howard Lake, Long Lake, Mankato, Twin Cities—55¢
Watertown, S. D.	(Same points as Huron)—55¢	(Same points as Huron)—62¢

USE OF RASPBERRIES AND STRAWBERRIES FOR COMMERCIAL MANUFACTURE

The principal commercial uses of berries are in jam and preserves, in ice-cream manufacture, for soda fountain trade, and in the baking industry. No census data are available of the quantities of berries used for these various purposes. The probable quantities used locally, however, have been estimated by various methods and are given below. For each commercial use a particular type of berry is desirable. In certain cases the present types of berries grown in Minnesota appear suitable, but in other cases shipped-in berries appear to have more desirable characteristics.

Jam and Preserves

A survey made in 1935 showed that during the previous year preserving factories in St. Paul and Minneapolis purchased 1,340 fifty-gallon barrels of frozen-pack raspberries and 3,850 fifty-gallon barrels of frozen-pack strawberries. This is equivalent to 509,000 pounds or about 36 carloads of fresh raspberries and 1,347,500 pounds or about 107 carloads of fresh strawberries. The strawberries were computed on the basis of seven pounds of fresh berries per gallon of 2-1 pack (2 parts of berries—1 part of sugar). These berries were purchased for jam, preserves, and jelly. Jam is essentially the same product as a preserve, and only a very small proportion of the quantity purchased is used for jelly.

Most of the fruit is purchased in frozen form packed in fifty-gallon barrels. Strawberries are packed in sugar, but raspberries used by these factories generally are frozen without sugar. This pack is known to the trade as "cold pack," but in technical publications it is generally referred to as "frozen pack" to distinguish it from the term "cold pack" used in the canning industry where it refers to a pack made at prevailing room temperatures. Each barrel of raspberries contains about 380 pounds of berries, and each barrel of strawberries contains about 450 pounds of berries and sugar.

Use of Minnesota Raspberries

During 1934 about 7,700 pounds of Minnesota-grown raspberries were purchased by preserving factories in the Twin Cities, or about 1½ per cent of the total quantity bought. The principal sources of berries for preserving in Minnesota are Washington and Oregon, so the prices of Minnesota berries must be limited by the cost of berries from these sections. The cost of packing berries in barrels and placing them in cold storage is approximately two cents a pound. The freight rate on frozen berries from the State of Washington is 1.3 cents per pound. Therefore, the price paid by local factories for fresh raspberries is likely to be somewhat less than the price of berries packed in barrels at shipping points

on the west coast. The barrel price of frozen-pack raspberries at Portland, Oregon, in August 1935 was 9½ cents per pound.

The price paid for fresh raspberries at the local factories has averaged from seven to eight cents per pound during recent years. This is equal to about $1.15 to $1.32 per 24 pints. As the crates are returnable, this price is equivalent to a price of about $1.40 to $1.57 on the fresh fruit market. Because of crop shortage in 1935, local factories paid up to 9 cents per pound for fresh raspberries, which is equivalent to a price of about $1.81 per crate on the fresh fruit market.

The Latham and King varieties have been found satisfactory for jams and preserves, altho they are not considered equal to the Cuthbert for this purpose. Cuthbert is superior in color and the seeds do not separate from the pulp so readily during the preserving process. The Cuthbert is not well suited to Minnesota conditions. When Latham and King berries are used it is customary to mix them with Cuthbert berries, using 50 per cent or more of the latter variety.

Tests of the following varieties have been made by the Frozen Pack Laboratory of the United States Department of Agriculture at Seattle, Washington. They are listed in order of preference for preservation by freezing storage: Cuthbert, Lloyd George, Viking, Cayuga, Latham, Newman, Erskine Park, Chief, King, Herbert, Antwerp, Utah, Marlboro.[3]

A desirable raspberry for frozen-pack storage is one that does not crumble or collapse readily, lacks seediness, and has a deep red color and rich flavor. The berries should be of about the same maturity as for fresh shipment, and they may be held under refrigeration for several days before packing. The fruit is then sorted, washed, and packed. The Frozen Pack Laboratory recommends a temperature of 31° to 32° F., with a relative humidity of 85 per cent for the berries held for packing. When preservation of the individual character of each berry is not essential, the fruit may be frozen without sugar or a sugar pack can be used. Otherwise, a sucrose sirup pack is recommended. When airtight containers are used, the berries should be frozen at 15° F. or lower with subsequent storage at the same temperature. If non-airtight containers are used, the berries should be frozen and stored at a lower temperature, preferably at about 0° F. The freezing and storage of raspberries in the original crate involves too much expense to be of practical value in supplying berries for this industry.

Use of Minnesota Strawberries

During 1934 about 13,570 pounds of Minnesota-grown strawberries were purchased by preserving factories in the Twin Cities, or about one per cent of the total quantity bought. A bright red berry that does not

[3] Diehl, H. C., Pentzer, W. T., Berry, J. A., and Asbury, C. E. Suggestions for freezing foods are outlined. Bureau of Plant Industry, U.S.D.A. mimeograph circular from Western Canner and Packer, September, October, November, December, 1934.

turn dark after cooking is required for this purpose. The berry must not have a light flesh color. A firm berry of medium size is desired, about ¾ to 1 inch in diameter, and the seeds must be evenly distributed. Deformed berries with a large proportion of the seeds near the tip are very unsatisfactory for preserves. The 2-1 pack is preferred for jam and preserves by the local factories, each 50-gallon barrel holding about 300 pounds of hulled berries and about 150 pounds of sugar.

The cost of packing the berries in barrels and placing them in cold storage is approximately three cents per pound. In addition there will be shrinkage from hulling and sorting. Therefore, the price paid for fresh strawberries locally will be lower than the price of berries in barrels at shipping points on the west coast after due allowance is made for the cost of sugar used in the barrel pack.

The price paid for fresh strawberries at the local factories has averaged about five to six cents per pound during recent years. The price is equal to about $1.45 to $1.74 per 24 quarts, which would be equivalent to a price of about $1.75 to $2.04 per 24-quart crate on the fresh fruit market. The barrel price of frozen-pack strawberries at Portland, Oregon, in August 1935 was 8½ cents per pound for the 2-1 pack and 8¾ cents for the 3-1 pack.

The Marshall strawberry, which does not grow satisfactorily in Minnesota, is the outstanding variety for jam and preserves manufactured in this region. Both Klondike and Missionary are rated as good preserving varieties according to reports obtained during this survey, but they are not used locally. Preserving factories in certain eastern states consider Blakemore one of the very best varieties for preserving purposes. On the west coast Blakemore is not satisfactory for preserving according to Dr. H. C. Diehl of the United States Frozen Pack Laboratory at Seattle, Washington. Tests of Dorsett in Washington and Oregen indicate that this may be a satisfactory variety for the preserving industry.

Caldwell, Lutz, and Moon[4] working with strawberries grown in Maryland and Virginia tested a large number of varieties preserved by freezing in non-airtight paper containers. They rate the varieties as follows:

First rank: Big Joe, Klondike, Brandywine, Blakemore, Redheart
Second rank: Abington, Bliss, Chesapeake, Dr. Burrill, Premier, Portia, Missionary, Fairfax, Southland, Belt
Third rank: Aroma, Beaver, Big Booster, Bradford, Gandy, Gassett, Gene, Leman, Lupton, Pearl, Ridgely, Warfield

These tests indicate the relative value of each variety for storage by the frozen pack method, but this does not necessarily indicate their value for the commercial manufacture of preserves.

[4] Caldwell, J. S., Lutz, J. M., and Moon, H. H. Varietal behavior of strawberries and peaches preserved by frozen pack methods. Proc. Amer. Soc. Hort. Sci. 29:282-286. 1933.

The preparation and handling of strawberries for frozen-pack storage is similar to the method used for raspberries, except that the berries cannot be successfully stored without the addition of sucrose sirup or sugar. Hulling is generally done during the picking operation, but if more convenient this may be done just before packing. Washing must be very thoro. The Frozen Pack Laboratory recommends a 50 to 60 per cent sucrose sirup, with a concentration of 40 per cent permissible for certain varieties. A satisfactory sugar pack also can be made if the containers are well packed and the spaces between the berries filled with dry sugar, or a slight amount of heavy sirup may be used to coat the berries. The maximum freezing and storage temperature should be 15° F., but some varieties apparently are best at 0° F., especially when non-airtight containers are used according to recommendations of the Frozen Pack Laboratory.

It is possible that large-scale production of both strawberries and raspberries for preserving factories may be found profitable in this state. Careful tests, however, will be necessary to determine whether any of the varieties that can be grown satisfactorily in Minnesota are suitable for the preserving industry. These tests must be made with Minnesota-grown fruit because the preserving quality of a variety may differ according to the locality in which it is grown. While the quantity of berries used by these factories is very large, most of this volume is contracted for in advance of the crop season and factories will not desire to handle large quantities of berries except on a contract basis.

Berries Used for Ice Cream Manufacture

An analysis of the different flavors of ice cream manufactured in the United States was made in 1931 by the International Association of Ice Cream Manufacturers. These data show strawberry-flavored ice cream as constituting 8.27 per cent of the ice cream and raspberry flavor 0.17 per cent.[5]

Production of ice cream in Minnesota was reported as 4,892,663 gallons in 1934 by the Minnesota State Department of Agriculture, Dairy, and Food. Based on the proportions shown by the International Association of Ice Cream Manufacturers, there was a production of 404,623 gallons of strawberry-flavored ice cream and 8,318 gallons of raspberry-flavored ice cream in Minnesota during 1934.

A survey of ice cream factories in St. Paul and Minneapolis made in 1935 showed that most of the strawberries used by these factories are purchased from the west coast and are shipped frozen in sugar. The larger factories buy the berries in fifty-gallon barrels of about 450 pounds capacity, and the smaller factories buy them in smaller containers. The Marshall variety is used and is packed mostly in the proportion of three

[5] Special Bulletin 42. International Association of Ice Cream Manufacturers, Harrisburg, Pa. March 1933.

pounds of fruit to one pound of sugar, altho some 2-1 pack is used. A 3-1 pack is preferred because it adds less sugar to the mix than a 2-1 pack and therefore produces an ice cream that remains firmer at the usual cabinet temperatures. A very small proportion of the berries came from the east, and these consisted of the Premier variety.

The quantity of 3-1 pack used by different manufacturers in each gallon of strawberry ice cream will vary to some extent, but will average about three-quarters of a gallon to each 10 gallons of ice cream. The estimated quantity of strawberries used in Minnesota for ice cream manufacture in 1934 on the basis of the foregoing data is 30,346 gallons of 3-1 frozen pack or equivalent, which would equal 227,595 pounds of fresh berries or about 18 carloads. This includes sherbets and water ices and is computed on the basis of 7½ pounds of fresh berries per gallon of 3-1 pack.

A small proportion of the total quantity of strawberries used in ice cream is purchased locally during the crop season. According to estimates secured from manufacturers, the total quantity of Minnesota-grown berries purchased for this purpose probably does not exceed 20,000 pounds annually.

The total quantity of raspberries used in ice cream in Minnesota probably does not exceed the equivalent of 6,000 pounds of the fresh berries, of which not more than about 1,000 pounds comes from Minnesota growers.

Fresh Fruit Versus Frozen Pack and Canned Berries

It is generally believed in the ice cream industry that fresh strawberries are superior to frozen-pack berries and to canned berries for flavoring ice cream. Also it is generally believed that the frozen pack is superior to the canned product and that both are much superior to alcoholic strawberry extract which is the cheapest source of flavor. These conclusions are supported by Fabricius[6] and other investigators.

Many ice cream makers having a small volume of output must rely on canned strawberries for their strawberry ice cream except during the fresh fruit season, because storage facilities are not available for frozen-pack berries. They are purchased usually in No. 10 cans, each can holding about three quarts of fruit. Some quart cans also are used. A special pack is used that is prepared particularly for the ice cream trade.

Another factor that may have an influence on the consumption of strawberries in ice cream manufacture is the increase in the number of smaller freezing units, commonly known as counter freezers. The cost of these units has been reduced greatly within the last two years, and the number in use is increasing rapidly. This development should result in a wider use of local berries during the fresh fruit season, including

[6] Fabricius, N. E. Strawberries for Ice Cream Manufacture. Iowa Agr. Exp. Sta. Circ. 132. 1931.

the season for fall-bearing varieties, because fresh berries are much preferred to the canned or frozen product. It is likely also to increase the demand for canned or frozen berries in small containers.

Use of Minnesota-Grown Berries

Minnesota-grown strawberries are not used in large volume by ice cream manufacturers because too little suitable fruit is available at competitive prices. There are several reasons for this. In past years the fresh fruit market ordinarily has offered a better return to local producers than could be secured in competition with the market price on frozen berries. With increasing production this margin between fresh fruit and frozen-pack berries is likely to shrink. In fact, during 1935 berries in some localities of Minnesota were sold at lower prices than were paid to growers on the west coast by canning factories. Prices paid for 3-1 frozen-pack strawberries at St. Paul in 50-gallon barrels in 1935 were equivalent to a price of about 12 cents per pound for the hulled fruit.

In preparing strawberries for preservation by freezing, there is a shrinkage in weight that must be considered in comparing prices paid for fresh fruit with the cost of frozen-pack berries. Tests made with four varieties of ever-bearing strawberries showed a shrinkage of 3 to 5 per cent after the stems were removed. These samples did not include any overripe berries or any small, hard berries which would normally be discarded in the hulling operation.

Tracy, Ramsey, and Ruehe[7] report an average shrinkage of 2.5 pounds per 24-quart crate of Dunlap strawberries, including loss from stems and from overripe and hard green berries. They found that a 24-quart crate of Dunlap strawberries yielded an average of 4.2 gallons of 2-1 frozen pack and an average of 3.85 gallons of 3-1 frozen pack. One Minnesota grower who washed and hulled a quantity of small-sized berries for sale to ice cream manufacturers reported that one girl could wash and hull about 100 pounds of berries in 10 hours.

The survey conducted as a part of this investigation suggests a possible market of considerable extent in this industry for Minnesota-grown strawberries. In order to develop this market, it will be necessary to select suitable varieties and to prepare them for use in ice cream. A start in this direction has been made, and some growers are now marketing a small volume of washed and hulled berries for this purpose. Small sizes of one variety were used for this purpose. Factories using these local berries found they produced an exceptionally fine flavor, resulting in a decided increase in the volume of strawberry ice cream sold.

Larger-scale operations will involve facilities for freezing and storage. Ice cream manufacturers prefer to buy strawberries already washed and

[7] Tracy, P. H., Ramsey, R. J., and Ruehe, H. A. A study of the causes of a stale metallic flavor in strawberry ice cream. Ill. Agr. Exp. Sta. Bul. 407. 1934.

hulled because the strawberry season comes at a time of the year when the factories are very busy. These factories seldom have storage facilities to take care of one year's supply of frozen berries, so commercial storage must be available.

Raspberries are used very little in the manufacture of ice cream. One of the largest factories in the Twin Cities made an attempt during the last two years to establish raspberry ice cream on a regular production basis but found that raspberry ice cream was not a popular item in the trade. Most of the raspberries are used in sherbets. For the present, there is no local outlet for any volume of Minnesota raspberries in the manufacture of ice cream.

Strawberry Varieties for Ice Cream Manufacture

The development of a market for Minnesota-grown strawberries in ice cream manufacture will be aided greatly by experimental work to determine the most suitable varieties of Minnesota-grown berries. Very little is known about the value of locally grown strawberries for this purpose and ice cream manufacturers are not familiar with local strawberry varieties. The quality of a strawberry variety may be very good in one locality but in another may be poor because of different climatic conditions.

The most important requirement for berries used in this industry is good flavor and the ability of the variety to retain this flavor during the manufacturing process. Color is of much less importance, because color is added to the finished product. Firm berries of medium size are preferred.

In Massachusetts, Mack and Fellers[8] report Premier equal to Marshall, with Howard Supreme superior to both these varieties. Dunlap and Mastodon were found somewhat lacking in flavor. The Marshall in this instance was Eastern-grown. In Illinois, Tracy, Ramsey, and Ruehe[9] found that Dunlap produced the finest-flavored ice cream, being superior to Premier in this respect. Fabricius, in Iowa, found Dunlap to be a very desirable variety for ice cream manufacture.

Crushed Fruits for Soda Fountain Trade

Large quantities of strawberries are used in the preparation of preserves for the soda fountain trade. Preserves manufactured for this purpose are commonly known as "crushed fruit," but as a matter of fact the berries must be whole and must retain their shape to be satisfactory for this trade.

[8] Mack, M. J., and Fellers, C. R. Frozen fruits and their utilization in frozen dairy products. Mass. Agr. Exp. Sta. Bul. 287. 1932.

[9] Tracy, P. H., Ramsey, R. J., and Ruehe, H. A. A study of the causes of a stale metallic flavor in strawberry ice cream. Ill. Agr. Exp. Sta. Bul. 407. 1934.

Berries of medium size are preferred, and it is necessary to select a variety that will retain a good flavor in the finished product. Color is not important, because it is customary to add color. The Marshall strawberry is commonly used in this territory to manufacture preserves for the fountain trade. The 2-1 or 3-1 frozen pack is used extensively for this purpose. The berries are put up in No. 10 cans and in glass jars. Raspberries are seldom used.

No statistics are available on the volume of strawberries consumed in this manner. One of the large retail distributors[10] reported that 250 gallons of crushed strawberries (3-1 pack) were supplied to their stores during the same period in which 63,000 gallons of ice cream were sold. This shows a consumption of approximately 4 gallons of crushed strawberries to each 1,000 gallons of ice cream sold. If the proportion of crushed strawberries to total ice cream sales for the state is the same as for this large distributor, then 19,571 gallons of strawberry preserves were used for this purpose in the state in 1934. This is the equivalent of 146,780 pounds of fresh strawberries, or about 11 carloads, computed on the basis of 7½ pounds of fresh berries per gallon of 3-1 pack.

Berries Used in the Baking Industry

A relatively large volume of raspberries and strawberries is used in the baking industry, but there are so many organizations and individual operators engaged in this trade that statistics are difficult to obtain.

Frozen-pack raspberries and strawberries are used extensively by pie manufacturers, one large company reporting the use of approximately 20,000 pounds of raspberries and 20,000 pounds of strawberries annually. Raspberries are used widely in the form of imitation jelly for jelly rolls and similar bakery products, the imitation jelly usually containing about 10 per cent of the true fruit preserve.

A conservative estimate of the total quantity of these fruits used annually in the baking industry in Minnesota is 185,000 pounds of raspberries and 150,000 pounds of strawberries.

Commercial Canning

The canning industry desires a deep red berry that holds its red color when cooked. There are no commercial factories in Minnesota canning raspberries and strawberries, so there is no local outlet for berries for commercial canning at the present time.

Quantity of Berries Used in Minnesota for Commercial Manufacture

A summary of the data previously given shows that approximately 50 carloads of raspberries and 149 carloads of strawberries were used

[10] The Walgreen Company, Minneapolis.

in Minnesota for commercial manufacture in 1934. This is shown in Table 6.

Table 6. Raspberries and Strawberries Used in Minnesota for Commercial Manufacture in 1934

	Pounds of fresh fruit or equivalent	Equivalent number of carloads	Approximate value
Raspberries	700,000	50	$ 98,000
Strawberries	1,871,875	149	149,750

Less than two per cent of all the raspberries and strawberries used for this purpose were grown in Minnesota, according to data secured in this survey, and this is typical of average years according to the manufacturers from whom these data were secured. The quantity of fruit purchased in Minnesota is shown in Tables 7 and 8.

Table 7. Source of Raspberries Used in Commercial Manufacture in Minnesota in 1934*

Manufactured product	Grown in Minnesota	Grown in other states	Per cent of total grown in Minnesota
	lbs.	lbs.	per cent
Jam and preserves	7,700	501,300	1.5
Ice cream	1,000	5,000	16.7
Soda fountain fruit	Negligible	Negligible	.....
Total	8,700	506,300	1.7

* Quantity of fruit used in the baking industry not included because data on source of this fruit are not available.

Table 8. Source of Strawberries Used in Commercial Manufacture in Minnesota in 1934*

Manufactured product	Grown in Minnesota	Grown in other states	Per cent of total grown in Minnesota
	lbs.	lbs.	per cent
Jam and preserves	13,570	1,333,930	1.0
Ice cream	20,000	207,595	8.8
Soda fountain fruit	Negligible	146,780	.....
Total	33,570	1,688,305	1.9

* Quantity of fruit used in the baking industry not included because data on source of this fruit are not available.

A very large proportion of the raspberries and strawberries used in commercial manufacture are made up into jam and preserves as shown in Figure 6.

An idea of the importance of the commercial manufacture may be gained by comparison between the total quantity of raspberries and strawberries used in commercial manufacture in Minnesota in 1934 and the total quantity of these fruits sold by the five co-operative marketing associations in Minnesota in 1935. The former used approximately 700,000 pounds of raspberries and 1,871,875 pounds of strawberries,

while the five marketing associations in Minnesota sold 354,568 pounds of raspberries and 569,195 pounds of strawberries. This comparison shows that the quantity of berries used in commercial manufacture in Minnesota exceeded nearly three times the total quantity of berries sold by the co-operative marketing associations. These five marketing associations do not handle the entire commercial crop of berries in Minnesota. Large quantities of raspberries and strawberries are sold through other channels, but the comparison indicates clearly the great volume of berries used in commercial manufacture in the state.

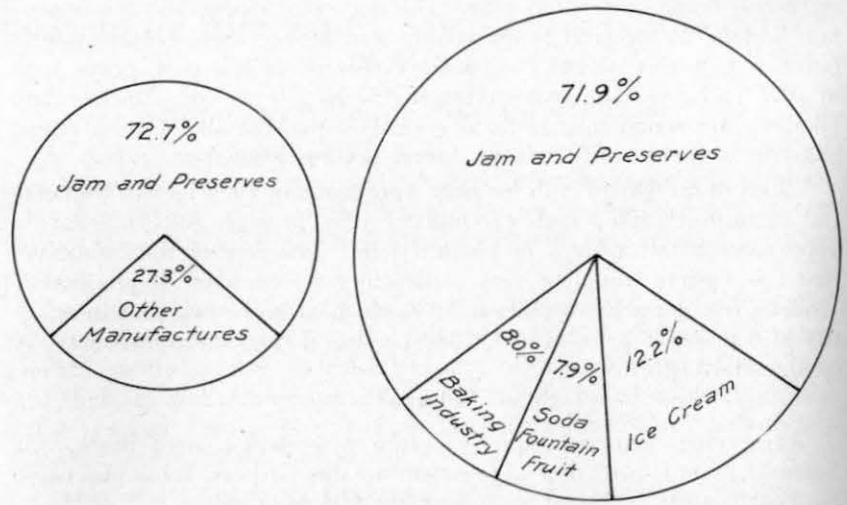


FIG. 6. USE OF RASPBERRIES AND STRAWBERRIES IN COMMERCIAL MANUFACTURE IN MINNESOTA IN 1934

The extensive use of shipped-in berries does not mean that there is an existing market for Minnesota berries in these commercial uses. There are undoubtedly valid reasons for the predominant use of western berries. For Minnesota growers to compete successfully for this market, it will be necessary for them to grow a type of berry desired by the processors and to provide it in quantity at prices as low as other sources of supply available to the processors. Whether this is possible or profitable remains to be demonstrated.

USE OF MINNESOTA APPLES, PLUMS, AND GRAPES FOR COMMERCIAL MANUFACTURE

There are important commercial uses of apples in the manufacture of apple butter and jelly, as baked apples in hotels and restaurants, and in bakery products such as pies. Plums are used for preserves and jelly, and grapes for juice and jelly. Low cost appears to be essential for

apples used in apple butter and jelly, but baking apples and pie apples require special characteristics. This is especially true of baking apples, and if Minnesota growers could provide apples of the desired characteristics they would undoubtedly compete successfully with other apples on the market. Certain varieties of the dark-fleshed plums now being grown seem to be well adapted for the making of jam and preserves commercially.

Apples and Crabs

Almost any variety and size of apple is satisfactory for the manufacture of apple butter and jelly. The degree of ripeness is not important as long as the fruit is reasonably sound. For these reasons apples purchased by commercial factories are secured at low cost, prices paid in 1935 (a heavy crop year) averaging $7 to $10 per ton. Duchess and Okabena are found to give factory yields somewhat above the average, in terms of the quantity of apple butter per bushel of fruit.

Tests of the Dolgo crab for jelly were made in 1935 by two commercial factories.[11] This crab produces a jelly of high color, similar in appearance to strawberry or currant jelly. The factory tests indicated that this variety would be very satisfactory for commercial production. Under present market conditions it would have to be available in quantity at a probable price of about $20 per ton if used in large volume by commercial factories.

Plums

Preserving factories require a plum with dark-colored flesh. The Satsuma plum is used to a large extent for this purpose, being purchased by local factories in dried form with the pits removed.

In August 1935 samples of several Minnesota-grown plums and cherry-plums were submitted for factory test. Both Hennepin and Sapa were found to be very satisfactory for commercial production, and when these two varieties were mixed in equal proportion a preserve of exceptional quality was produced. These two varieties mixed in equal proportion also made an excellent jelly. As a result of these tests, several tons of Sapa cherry-plum were purchased immediately from a grower by one of these factories. It is probable that a considerable volume of both varieties can be utilized by commercial factories. Under present market conditions these varieties could be expected to bring from $60 to $100 per ton at the factory.

Several other varieties of Minnesota plums were submitted to these factories for examination, but no actual factory tests were made. The Oka cherry-plum appeared to be equally as satisfactory as the Sapa. Several named varieties of Minnesota hybrid plums were considered unsuitable because of their flesh color. The St. Anthony cherry-plum

[11] The authors wish to acknowledge the valuable assistance given by Wheeler-Barnes Company of Minneapolis and by Griggs-Cooper Company of St. Paul in making factory tests of new fruits for commercial preserves and jelly.

was considered unsuitable by one factory because of a high tannin content of the skin.

Grapes

No tests of Minnesota-grown grapes were made in connection with this project. However, the factories have been using limited quantities of Beta grapes for a number of years. It is not probable that any large volume of this variety will be used, because the color of the manufactured product is inferior to that produced from the Concord grape and the berry does not yield sufficient pulp.

VALUE OF MINNESOTA APPLES FOR COMMERCIAL BAKING

Requirements for the Baked Apple Trade

A survey was made during 1935 to determine what varieties of apples are being used commercially in some of the best hotels and restaurants for baking. Ten of the leading hotels and restaurants in the Twin Cities and in Rochester, Minnesota, were interviewed for this purpose.

In nine of these places the Rome is being used to the exclusion of all other varieties, except late in the season when Rome apples are not available on the market, at which time five of these places use the Winesap. The remaining four usually do not supply baked apples after the Rome is gone. One hotel was using Minnesota-grown McIntosh as the preferred variety during its season.

Fancy and extra fancy grades are used mostly for this purpose. A large-sized apple is required. Five of the places use a 64 or 72 size, one uses a 72 or 80 size, two use an 88 or 96 size, and two use a 104 or 112 size. The 64 size is a 3¾-inch apple and the 112 size is a 3-inch apple.

Many of the smaller hotels and restaurants use a wider range of varieties for baked apples, depending to some extent on the varieties readily available. The Jonathan is used to some extent, and late in the season the Winesap is frequently used. Delicious is not a satisfactory apple for baking. The most widely grown winter apple in Minnesota at the present time, the Northwestern, is unsuited to the best class of hotel and restaurant trade because it does not hold its shape well and is not so attractive when baked as the Rome.

In the testing of new varieties for their value for baking, it is obvious that Rome should be used as the standard of comparison. According to the consensus of opinion among these hotels and restaurants, an apple to be used for baking should meet the following requirements:

1. The apple must be free from worms.
2. The size of the fruit must be uniform and as specified by the baker.

3. The apple must be available for a reasonably long period.
4. The apple must be of good flavor when cooked and not too acid.
5. The fruit must retain its shape during the cooking process.
6. The skin and the flesh color must be attractive when cooked.
7. The flesh must cook evenly to the core.

It is apparent that not only the cooking value of fruit itself must be considered, but also cultural practices, grading, and storage quality. The purchaser of apples for this purpose demands fruit from well-sprayed orchards where freedom from worms is assured. The apples when baked must be uniform in size, not only from day to day but from month to month.

Color of the fresh fruit is not important, because color is judged on the basis of the cooked product. The variety must keep well over a long period of time. A succession of different varieties would involve changes in quality of the product and would not permit the same degree of standardization in their method of preparation.

There is an opportunity in Minnesota for the production of fruit for the baked apple trade if a suitable variety can be grown here. Because very few apple varieties possess the desired qualifications, a good baking apple commands a premium on the market. This is shown in Table 9 which records the price of fancy-grade, Washington-grown Rome on the Minneapolis market from October 15 to November 25, 1935, with the price of Minnesota Wealthy apples and fancy-grade, Washington-grown Jonathan apples included for comparison. The prices for Rome and Jonathan are by the box, and for Wealthy by the bushel basket.

Table 9. Price of Rome, Jonathan, and Wealthy Apples on the Minneapolis Market, October 15 to November 25, 1935

	Washington Rome, 113 size and larger, fancy grade	Washington Jonathan, 100 to 163 size, fancy grade	Minnesota Wealthy, best grade
	box	box	bushel
October 15	Not on market	$1.45	$0.75 to 1.00
October 21	Not on market	1.45	0.75 to 1.00
October 25	$1.65	1.45	.75 to 1.00
November 1	1.65	1.45-1.50	.50 to .75
November 5	1.65	1.45-1.50	.50 to .75
November 9	1.65	1.65	.90
November 15	1.65	1.65	1.00
November 20	1.65	1.65	1.00
November 25	1.65	1.65	.90

Tests of Minnesota Varieties for Baked Apples

Because none of the standard apple varieties commonly grown in Minnesota equal the Rome for the baked apple trade, a careful survey was made among the new selections under test at the University of Minnesota Fruit Breeding Farm for varieties that might meet the requirements of the trade. As a result of this survey, 13 varieties were selected for further testing. One variety from the Iowa Agricultural

Experiment Station, the Joan, was included in these tests, making a total of 14 varieties.

Arrangements were made with the Division of Home Economics at University Farm to make a preliminary cooking test of these selected varieties, and further tests were arranged through the courtesy of several of the larger hotels and restaurants in St. Paul and Minneapolis.[12]

FIG. 7. MINN. NO. 790 APPLE BAKED BY ONE OF THE LARGEST MINNEAPOLIS HOTELS

Note the firm shape after cooking. (Photograph taken on March 13, 1936.)

A variety to be of any material commercial value must be equal in baking quality to Rome. Any apple that does not measure up to this standard cannot hope to attain commercial importance, unless perhaps for a limited period in the fall before Rome can be purchased on the local market or late in the season after Rome is off the market.

Results of the preliminary tests made by the Division of Home Economics were not recorded from the standpoint of commercial practice, and these ratings[13] will necessarily differ to some extent from those shown for the same varieties in Table 10. This is because one unfavorable

[12] The authors wish to acknowledge the splendid co-operation extended by the following hotels and restaurants in making possible the tests of these apples under actual commercial conditions: Greater Hotel Lowry, St. Paul; Hotel St. Paul, St. Paul; The Golden Rule, St. Paul; Schunemans and Mannheimers, St. Paul; The Eat Shop, St. Paul; The Dayton Company, Minneapolis; Nicollet Hotel, Minneapolis; the Cafeteria, University Farm.

[13] Unpublished data by Alice M. Child. The authors hereby wish to acknowledge the active assistance and co-operation extended by the Division of Home Economics in connection with the testing of apples for baking.

factor may be sufficient to completely disqualify a variety for commercial use. An apple that will not retain its shape until the flesh is thoroly cooked to the core is not a satisfactory commercial variety even tho it scores perfect in all other respects. Size is another factor to be considered, as illustrated by the Haralson apple. Tests of this variety made by the Division of Home Economics show it to have the very highest rating as a baked apple, and also for pie and sauce. However, only a small proportion of the crop is likely to be of the large size required for the baked apple trade of the best hotels and restaurants. Haralson is an excellent cooking apple for home use and commercially where the trade demands an apple of medium size.

Results of the commercial tests proved to be remarkably uniform, altho, as is always true in personal judgment of food products, there were some differences of opinion as to the value of the varieties tested.

A summary of the tests made by the hotels and restaurants is given in Table 10. The ratings shown may be interpreted as follows:

VERY GOOD—Equal to Rome and entirely satisfactory for commercial use.

FAIRLY GOOD—Not as good as Rome, but probably acceptable for commercial use to a certain extent.

FAIR—Ordinarily would not be used if better varieties were available.

POOR—Unsatisfactory for commercial use under any conditions.

Table 10. Result of Baked Apple Tests by Restaurants and Hotels

Variety tested	Number places testing	Ratings			
		Very good	Fairly good	Fair	Poor
Minn. No. 790	4	4	.....	.....	.....
Joan	4	2	1	1	.....
Wedge	4	.....	4	.....	.....
Folwell	2	.....	1	1	.....
Minn. No. 1014	3	.....	1	2	.....
Minn. No. 1007	2	.....	1	1	.....
Minn. No. 838	4	.....	2	1	1
Minn. No. 821	3	.....	1	1	1
Minn. No. 991	1	.....	.....	1	.....
Minn. No. 643	2	.....	.....	.....	2
Minn. No. 995	1	.....	.....	.....	1
Minn. No. 1008	2	.....	.....	.....	2
Minn. No. 658	2	.....	.....	.....	2
Minn. No. 792	1	.....	.....	.....	1

These tests show that Minn. No. 790 is an exceptionally good baking apple. Fortunately it is also an apple of very good eating quality, in this respect superior to Rome and to Joan. The apple attains a large size, hangs well to the tree, and keeps well in storage. Tests of this variety at the Fruit Breeding Farm are not completed, and it has therefore not yet been recommended for general planting.

Joan was found to be fully equal to Minn. No. 790 in appearance as a baked apple, but in two of the four commercial tests its quality when baked was considered somewhat disappointing.

Wedge is an apple that matures early and comes on the market several weeks ahead of Rome. In 1935 the Rome did not appear on the Minneapolis market until October 22. Wedge may find a good market as a commercial baking apple during this period. It is an excellent baking apple for home use during its season. The apple is large and keeps well in storage, but it does not hang well to the tree. It is ready to pick in the latter part of the Wealthy season.

None of the remaining 11 varieties included in these tests show any real indication of commercial value for the baked apple trade, altho a number of them appeared desirable for home use as baking apples.

Requirements for Commercial Pie Making

The requirements for a good pie apple are different in some respects from those for the baked apple trade, according to a survey conducted as a part of this investigation. A first-class pie must have an attractive appearance with a crisp, golden-brown crust that does not fall away from the filling. A good pie apple is one that will remain firm after baking, so that the slices used for the filling will retain their shape as much as possible and yet be soft in texture. The color of the filling should be as light and clear as possible. Apples that have a dark muddy color when cooked or that are decidedly green in color in the filling are not desirable. The apple must not be too juicy, and too great a degree of acidity is not desired because it is necessary to use larger quantities of sugar. Color of the fresh fruit is of no importance.

Apples having a narrow seed cavity are preferred because coring machines cut a hole about 11/16 inch in diameter, and all the seeds are not taken out if the cavity is wide. Apples of uniform size are most satisfactory for handling. Pie factories do not like to handle apples smaller than the 2¼-inch size or larger than the 3-inch size.

Arkansas Black, Rhode Island, Northwestern, Rome, Willow, and Winesap are used extensively for pie making. Duchess and Patten also are used, but their season is too short to permit their use in large volume. This is especially true of Duchess, because as soon as the apples become at all mealy they are unsatisfactory for pie making. The Duchess also has a very large seed cavity, which is objectionable. One factory stated that Patten "foams" too much in baking to be a satisfactory commercial variety.

Wealthy is used to some extent, especially when green, but it is considered too tart and too juicy for the best results. Jonathan is fairly good for this purpose. Varieties such as Delicious, McIntosh, and Ben Davis are unsatisfactory, the latter requiring too much time for cooking. The actual choice of varieties depends largely on which of the better pie apples are available at the lowest price.

The pie industry does not require nearly as high a grade of apple as is used for baking. For this reason, it would not be profitable to grow an apple particularly for this trade. However, large quantities of second-grade apples are used in this industry, and it offers a ready market for fruits of medium size and uniform grade that are suitable for pie making.

There are three large pie factories in the Twin Cities with a combined output of sufficient volume to use approximately 30 to 50 carloads of apples each year. In addition, there are numerous other bakeries in the Twin Cities using apples for pie making. No statistics are available on the total volume of apples used in this industry.

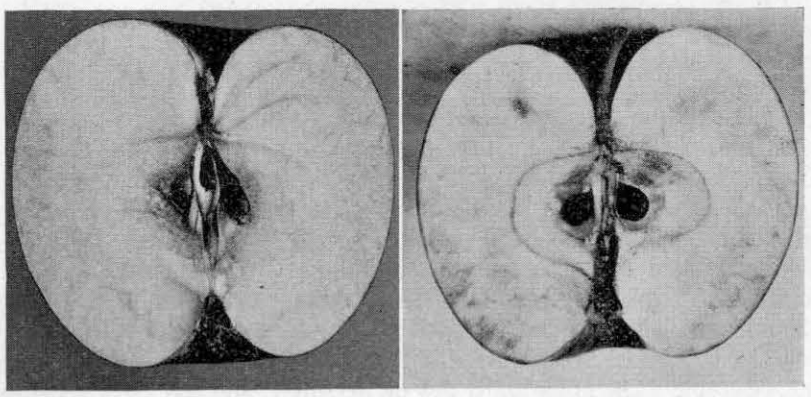


FIG. 8. LEFT: HARALSON, A GOOD PIE APPLE, WITH SMALL SEED CAVITY; RIGHT: APPLE WITH LARGE SEED CAVITY (DUCHESS)

Tests of Minnesota Apples for Pie Making

Northwestern is practically the only late-keeping apple grown in Minnesota that has been used in the pie industry. For this reason, a number of the more promising of the named varieties and new selections from the University of Minnesota Fruit Breeding Farm were tested for pie making. The variety Joan, from the Iowa station, also was included in these tests. In the testing of apples for pie making, baking, or for sauce, it is necessary that the apples be well matured and in good condition, otherwise results may be very misleading. It is important to note that a given variety may be excellent for cooking during its proper season, but if used too early or too late in the season it is likely to be inferior.

The first tests were made by the Division of Home Economics, and results indicated that most of the 13 varieties tested were suitable for pie making. Arrangements then were made with several commercial pie factories, bakeries, and restaurants in St. Paul and Minneapolis[14] to

[14] The authors wish to acknowledge the splendid co-operation extended by the following organizations: The Eat Shop, St. Paul; Paramount Pie Company, St. Paul; Rainbow Pie Company, St. Paul; Egekvist's Bakeries Inc., Minneapolis; Lakeview Pie Company, Minneapolis.

conduct a comprehensive test of these varieties under commercial conditions. A summary of these tests is shown in Table 11.

These tests show that all varieties would be satisfactory as commercial pie apples. The outstanding varieties as pie apples were found to be: Haralson, Wedge, Minn. No. 643, Minn. No. 995, Minn. No. 1008, and Minn. No. 1014.

Table 11. Results of Apple Pie Tests by Pie Factories, Bakeries, and Restaurants

Variety tested	Number places testing	Ratings				
		Excellent	Very good	Good	Fairly good	Fair
Haralson	2	.....	2	.....	.....	.....
Joan	2	.....	.....	2	.....	.....
Wedge	2	.....	2	.....	.....	.....
Minn. No. 643	2	1	.....	1	.....	.....
Minn. No. 658	1	.....	.....	1	.....	.....
Minn. No. 790	3	.....	.....	1	1	1
Minn. No. 821	2	.....	1	.....	1	.....
Minn. No. 838	2	.....	.....	1	1	.....
Minn. No. 991	2	.....	.....	2	.....	.....
Minn. No. 995	2	1	.....	1	.....	.....
Minn. No. 1007	2	.....	.....	2	.....	.....
Minn. No. 1008	2	.....	1	1	.....	.....
Minn. No. 1014	2	.....	2	.....	.....	.....

Apples that have a long storage season are preferred by the pie factories because such varieties furnish an adequate supply during the late winter and spring months. A quantity of Haralson apples were kept in cold storage until June 22 and then were tested by one of the pie factories that had made tests of the same variety earlier in the season. These apples came out of storage in excellent condition and were rated "very good" for pie making in a test made on June 25.

CONCLUSIONS

A survey of the principal berry shipping associations in the United States indicated that more than one-half of these associations are using the U. S. standard grades or their equivalent.

Crates of strawberries and raspberries offered for sale in Minnesota must bear the date of packing and the name of the grower or the name of the shipping association and the grower's number. Legal regulations require that the container shall be full when offered for sale. Only new containers may be used and these must conform to the provisions of the United States Standard Container Act.

Almost the entire crop of Minnesota-grown raspberries and strawberries is sold as fresh fruit for table use or for home canning. There are five active co-operative marketing associations in Minnesota which in 1935 handled 21,489 24-pint crates of raspberries and the equivalent of 20,328 24-quart crates of strawberries. This is only a part of the total commercial crop in the state.

The express and truck rates from the various shipping points to consuming markets are of considerable importance in the price to producers for berries. An analysis was made of the express rates for L.C.L. shipments between 20 Minnesota and Wisconsin shipping points and 30 consuming markets. LaCrosse, Wisconsin, has the lowest average weighted rate to all the 30 markets. LaCrescent, Minnesota, which is directly across the Mississippi River from La Crosse, has an average weighted rate of 10 cents per strawberry crate higher. An analysis of the truck rate structure was not advisable at the time of this survey because of pending changes due to truck rates coming under the supervision of the Interstate Commerce Commission effective October 1, 1935.

Commercial factories in Minnesota spend approximately one-quarter of a million dollars annually for raspberries and strawberries, with less than two per cent of this sum expended for Minnesota-grown berries. This quantity represents nearly three times the amount of berries sold as fresh fruit in 1935 by all the co-operative marketing associations in Minnesota.

There is a wide market for Minnesota-grown raspberries in the preserving industry at prevailing market prices for preserving berries. A hardy red raspberry of preserving quality equal or superior to the Cuthbert variety would be of immediate commercial value to Minnesota growers.

Not enough data are available concerning the value of Minnesota-grown strawberries for frozen-pack storage and for the manufacture of preserves. There will be no large market for Minnesota strawberries in the preserving industry until it is shown that good preserving varieties can be grown locally.

There is an opportunity for developing a market for Minnesota strawberries in the ice cream industry, if the berries are packed in containers of suitable size and are preserved by the frozen-pack method. There is no sizable market for raspberries in the ice cream industry. Data on other possible markets for berries in commercial manufacture are given.

Factory tests of Dolgo crab, Hennepin plum, and Sapa cherry-plum indicated that these varieties are very satisfactory for commercial preserves and jelly.

An investigation was made to determine the requirements of apples now used for the baked apple trade and for commercial pie making. It was found that very few apples can meet the requirements of the baked apple trade. Fourteen of the most promising Minnesota varieties were given a comprehensive test under actual commercial conditions. Most of the varieties tested were found satisfactory for commercial pie manufacture, and one variety, Minn. No. 790, proved to be entirely satisfactory for the baked apple trade.

All new varieties of fruit recommended for commercial planting should undergo thorough commercial tests prior to general planting.